

## ARTERIOVENOUS ANASTOMOSIS.

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WHENEVER a new branch of surgery is entered upon a long time may be necessary before any one man can definitely decide from his own cases on its usefulness. Reports of isolated cases from different observers are here helpful. I therefore report the following case of arteriovenous anastomosis which is, I believe, one of the earliest, if not the first, in which the suggestion of Carrel and Guthrie <sup>1</sup> has been followed.

Dennis C., eighty years old, entered the service of Dr. George H. Monks, by whose kindness I was permitted to operate, at the Boston City Hospital the last of April, 1906. His history was of no special importance except that he had had heart trouble and had frozen his little toe the previous winter. He came to the hospital for gangrene of the middle toe of the right foot.

Physical Examination: Well developed and nourished. Heart, base second rib, apex in anterior axillary line under the sixth rib, loud systolic murmur transmitted to axilla. Pulmonary second sound accentuated. Lips blue. Radial arteries tortuous and all arteries markedly sclerotic. Abdomen negative. Left hydrocele. Middle toe right foot in condition of dry gangrene with œdema of foot to heel. No pulsation felt in dorsalis pedis. The urine was pale, acid, 1012, free from albumen, sugar or bile.

He was put upon appropriate treatment. The gangrene was kept dry but slowly progressed so that the middle toe sloughed off and the neighboring toes became involved in the process.

On May 10 under ether an arteriovenous anastomosis was done. The knee was flexed and the thigh rotated outward. An incision was made over the apex of Scarpa's triangle and carried down to the sartorius muscle, which was retracted outward. The

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<sup>1</sup> ANNALS OF SURGERY, Feb., 1906.

sheath of the vessel was opened and the artery freed for about two and a-half inches. The vessel was decidedly sclerotic. The vein lying behind and slightly to the outer side was freed for a corresponding distance. This required ligation of two or three small branches. A Crile clamp was placed on the artery at the proximal end of the freed portion and a split piece of rubber tubing was used to control the circulation at the distal part. A Crile clamp was put on the distal portion of the vein and a rubber tourniquet on the proximal. The artery and vein were each divided, the vein at a slightly higher level than the artery to facilitate the first anastomosis. The proximal end of the artery was then invaginated into the distal end of the vein. Three double-headed mattress sutures, placed equally distant on the circumference of the artery, were passed through the wall from the inside out. The needles passed within the vein for about a quarter of an inch were pushed through its wall from inside out. When the sutures were tied the artery was invaginated into the vein. Interrupted sutures then caught the overlapping vein to the wall of the artery, the whole thickness of the latter not being included in the sutures. Pagenstecher's celluloid thread No. 1 was used for all these sutures. The distal control tourniquet was removed from the vein below the anastomosis and the Crile clamp from the artery above the anastomosis. There was absolutely no leaking at the joint. The vein promptly partially filled and pulsated slightly. By a similar proceeding the distal end of the artery was invaginated into the proximal end of the vein. As the vessels had been divided at slightly different levels to aid in the first anastomosis some tension was necessary to connect these ends. A small clot which had formed in the end of the artery was wiped out before the anastomosis was begun. During the manipulations of this anastomosis the controlling tourniquet was pulled off the lower end of the artery, allowing some blood to escape from the distal end of the artery before it was again controlled. This blood was very dark and corresponded exactly in appearance to venous blood. When the anastomosis was completed and the controlling clamp and tourniquet removed the vein partially filled. The sartorius was then allowed to resume its normal position. The superficial fascia was sutured with catgut and the skin with silk-worm-gut. A dry sterile dressing and a spica bandage were put

on, holding the thigh flexed on the body to relieve tension on the vessels. The patient was fastened to a Bradford frame with pillows under the knee. The recovery from ether was good.

At first I was disappointed in the result of the first anastomosis, by which arterial blood was delivered by the artery to the vein by the failure of the vein to pulsate forcibly and to fill out to its full extent. This, however, is hardly to be expected for the possible calibre of the vein is much greater than that of the artery and its non-elastic walls would not transmit the pulsation. The fact that blood of venous appearance was in the lower end of the artery at the time of the second anastomosis may be explained in one of two ways; either the arterial blood had had time to go round through the veins and was trying to return as venous blood through the lower part of the artery, or the blood had been kept stationary in this portion of the vessel long enough to change in appearance. The blood was not dark-colored from the cyanosis of overetherization, for the patient at no time during the operation was more than lightly etherized. The fact that the vein filled after the second anastomosis, where the portion of artery which was expected to return venous blood was connected with the proximal end of the vein, seemed to me of importance, showing, I thought, some back flow up the artery.

After the operation there was no immediate change in the appearance of the leg. Its temperature was fully as warm as that of the other leg and there was no œdema. Some who watched the case thought as time went on that the superficial veins became a little more prominent than before the operation. The correctness of this observation I question. The veins never pulsated. The incision in the thigh healed by first intention in spite of the fact that the patient frequently tore off the dressing. The gangrene spread very slowly until the front portion of the foot, roughly that anterior to the tarso-metatarsal joint, became involved and here a line of demarcation formed. The patient was shown in this condition to those members of the American Medical Association who visited the hospital clinics and it seemed to be possible at that time to make the following deductions: Inasmuch as the circulation in the leg before operation was sufficiently poor to permit gangrene of the toes, and inasmuch as the femoral artery had been divided in Scarpa's triangle thus permitting

collateral circulation only through the profunda, it was fair to suppose that very little blood would have reached the lower leg through the collateral circulation and that the gangrene would rapidly have involved the leg unless as a result of the operation the veins were carrying the arterial blood. As the leg presented none of the appearances common to an extremity from which the blood has been shut off, and as the gangrene extended only very slowly finally forming a line of demarcation at about the tarso-metatarsal joint, the operation was considered to have been successful.

Amputation of course was necessary to remove the gangrenous portion of the foot. As an amputation at the point of election on the leg was considered preferable to one through the foot the leg was cut off on June 8. The operation was done without any tourniquet. Both anterior and posterior tibial arteries contained arterial blood which spurted out from the cut ends with fairly good force. The veins did not appear to contain any arterial blood. There was a slight separation of the skin of the flaps which left a very narrow area to heal by granulation. This required a rather long time and the patient was discharged on August 6.

What the meaning of the findings at the amputation is I do not know, and whether it vitiates all the deductions made earlier I must leave undecided. The case is reported simply as a case and each may draw his own conclusions.